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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS, OCTOBER, 1931

By HERBERT H. KIMBALL, in charge, Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January, 1931, REVIEW, page 41.

Table 1 shows that solar radiation intensities averaged above the normal values for October at Washington and close to normal at Madison and Lincoln.

Table 2 shows an excess in the total solar radiation received on a horizontal surface at Lincoln, Chicago, New York, Pittsburgh, and Fresno as compared with October normals for the respective stations; close to normal at Madison, and a deficit at Washington and Twin Falls.

Skylight polarization measurements made on 4 days at Washington give 63 for the mean percentage of polarization, with a maximum of 70 per cent on the 20th. At Madison, polarization measurements made on 10 days give a mean of 65 per cent with a maximum of 76 per cent on the 18th. These are above the corresponding averages for each station in October.

CORRECTION.—Owing to a misunderstanding as to the reduction factor that was required to reduce scale readings on the register to heat units the weekly averages given in Table 2 for September, 1931, for Twin Falls are too small. For the successive weeks they should read 523, 512, 398, and 464 and the departures from normal should be −9, +5, −77, and +29.

SOLAR RADIATION MEASUREMENTS AT FAIRBANKS, ALASKA

A request for the installation of apparatus for recording the intensity of solar radiation at Fairbanks was made some time ago by the agricultural experiment station at that place. It was not immediately complied with for the reason that the cover of the Weather Bureau thermoelectric pyrheliometer was secured to the metal base by cement, which did not make a permanently tight joint. Occasionally moisture condensed on the inside of the cover, which could be removed only after the instrument had been recalled to the central office.

The Eppley thermoelectric pyrheliometer is hermetically sealed inside a glass bulb, which has been carefully dried out. Little difficulty from condensation of moisture inside the bulb is therefore to be expected.

An Eppley pyrheliometer, recording on an Englehard microammeter was installed at Fairbanks early in August, 1931. It is exposed on a support 10 feet above the roof of the office building, where it has unobstructed exposure to the entire sky down to the horizon in all directions. The latitude of Fairbanks is 64° 52′ N., and the altitude of the pyrheliometer above sea level is about 500 feet.

Fairbanks is much farther north than any other station at which solar radiation measurements of this character are now systematically made. The nearest approach to it is Sloutzk, U. S. S. R., latitude 59° 41′ N. Records for the period September 4, 1927, to August 9, 1928, were, however, obtained at Green Harbor, Svalbard, latitude 78° 00′ N. They are summarized in the MONTHLY WEATHER REVIEW, April, 1931, vol. 59, p. 154. Green Harbor is well within the Arctic Circle, while Fairbanks is 1° 31′ below it. However, records from the latter station can not fail to be of interest.

The mean daily totals of radiation for each week in October are given in Table 2. The maximum daily amounts for each week are 61, 44, 42, and 40, respectively, and the corresponding hourly maxima are 11.9, 7.5, 8.1, and 7.5.

For the last three weeks in August the average daily amounts are, respectively, 322, 421, and 245, and the corresponding daily maxima are 486, 479, and 427. In September the averages for each week are, respectively, 55, 57, 40, and 46, while the maxima are 119, 103, 57, and 75. The average for the third week in August happens to be the same as the normal value for Washington for that week. All other averages are much less. In September the maximum daily amounts are less than the daily normals at any station in the United States in midwinter except in the smoky city of Chicago.

TABLE 1.—*Solar radiation intensities during October, 1931*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Oct. 3	12.24				0.86	1.19					11.38
Oct. 5	11.38	0.56	0.67	0.82	0.99						13.13
Oct. 10	7.57	0.68	0.81	0.96	1.13						7.04
Oct. 12	5.36	0.97	1.05	1.18							4.17
Oct. 13	4.37	0.59	0.95	1.09	1.15						4.37
Oct. 17	5.56	0.94	1.02	1.12	1.32						4.95
Oct. 19	5.36	0.80	0.90	1.08	1.27	1.48	1.29	1.09	0.97	0.83	4.37
Oct. 20	5.56	0.90	0.98	1.14	1.29	1.47	1.25	1.13	1.00	0.90	4.75
Oct. 21	7.04			0.78	1.02		1.00	0.72			8.18
Oct. 22	6.27	0.87	1.01	1.15	1.29	1.55	1.35	1.19	1.07	0.98	3.63
Oct. 23	6.27				1.02						6.02
Oct. 26	6.27	0.79	0.89	1.06	1.30		1.28	1.12	0.98	0.90	3.99
Means		0.79	0.92	1.04	1.15	1.42	1.23	1.05	1.00	0.90	
Departures		+0.04	+0.03	+0.09	+0.03	+0.01	+0.11	+0.11	+0.19	+0.18	
Madison, Wis.											
Oct. 1	9.83		0.92	1.03	1.21	1.44					7.29
Oct. 2	9.83			0.81	0.97	1.26					13.13
Oct. 5	7.87						1.10				7.87
Oct. 9	6.27		0.96	1.03	1.28	1.48	1.24				7.29
Oct. 16	6.76	0.85	0.98	1.08	1.23	1.46	1.31				6.02
Oct. 17	4.95		1.11	1.22	1.38						4.75
Oct. 19	5.36						1.17				7.57
Oct. 20	7.04		0.62	0.84	1.06	1.28	1.03				8.81
Oct. 21	8.18				0.92		1.04				9.83
Oct. 24	12.24				1.31						7.29
Oct. 28	5.36	0.63	0.83	1.09	1.31						4.17
Means		(0.74)	0.90	1.01	1.19	1.38	1.15				
Departures		−0.03	−0.01	−0.03	±0.00	−0.02	−0.04				
Lincoln, Nebr.											
Oct. 2	9.83	0.53	0.62				1.06				10.21
Oct. 4	12.24					1.42	1.19	0.98	0.85	0.74	12.24
Oct. 14	7.87	0.76		1.05							7.57
Oct. 15	7.29							1.15	1.04	0.95	8.81
Oct. 16	4.57	0.95	1.04	1.15	1.38			1.19	1.05	0.96	5.36
Oct. 17	5.79	0.47	0.70	0.90	1.27		1.31	1.18	1.03	0.93	6.02
Oct. 18	7.29						1.22	1.06	0.91	0.80	7.04
Oct. 19	9.47	0.88	0.97	1.10	1.21						11.38
Oct. 22	7.04	0.73	0.94	1.09	1.20		1.30	1.03			8.48
Oct. 23	11.81						1.19	1.07	0.91	0.80	10.21
Oct. 24	8.23							1.10	0.93	0.85	7.29
Oct. 27	3.30	0.85	0.98	1.10	1.32		1.28	1.16	1.02	0.94	4.57
Oct. 28	4.37		1.03	1.19	1.32						3.81
Means		0.74	0.90	1.08	1.28		1.22	1.10	0.97	0.87	
Departures		−0.11	−C.04	−0.02	±0.00		−0.03	+0.02	+0.02	+0.03	

[1] Extrapolated.

TABLE 2.—*Total solar radiation (direct+diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

AVERAGE DAILY TOTALS

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Pittsburgh	Gainesville	Fresno	La Jolla	Miami	Fairbanks
1931	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 1	303	280	333	310	273	394	276	----	445	266	474	28
Oct. 8	295	210	272	172	299	394	187	----	428	----	390	25
Oct. 15	284	290	343	292	265	338	211	----	378	----	335	28
Oct. 22	271	187	329	201	276	200	190	----	383	----	462	25
	DEPARTURES FROM WEEKLY NORMLS											
Oct. 1	−26	+11	+10	+97	+14	−8	+25	----	+27	−75	----	----
Oct. 8	−8	−34	−27	−22	+57	+8	−25	----	+34	----	----	----
Oct. 15	+2	+65	+40	+114	+49	−42	+14	----	+12	----	----	----
Oct. 22	+1	−18	+52	+41	+82	−136	+16	----	+51	----	----	----
Accumulated departures on Oct. 28, 1931	−688	+3,311	+2,177	+1,827	+1,890	+4,822	−1,401	----	+1,267	----	----	----

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, Superintendent United States Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, Perkins, and Mount Wilson observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Date	Eastern standard civil time	Heliographic: Diff. long.	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day
1931	*h* *m*	°	°	°			
Oct. 1 (Naval Observatory)	11 55	−40.0	309.9	+19.0	----	185	----
		−30.5	319.4	+19.5	31	----	216
Oct. 2 (Naval Observatory)	10 40	−28.0	309.3	+19.0	----	154	----
		−18.5	318.8	+19.0	25	----	179
Oct. 3 (Naval Observatory)	10 33	−14.0	310.2	+19.0	46	----	----
		−5.0	319.2	+19.5	15	----	61
Oct. 4 (Naval Observatory)	10 41	−68.0	243.0	−9.0	62	----	----
		−1.0	310.0	+19.0	46	----	----
		+8.0	319.0	+20.0	6	----	114
Oct. 5 (Naval Observatory)	10 46	−51.0	246.7	−9.5	31	----	----
		+12.0	309.7	+18.0	46	----	77
Oct. 6 (Naval Observatory)	10 48	−38.0	246.5	−10.0	15	----	----
		+26.5	311.0	+17.0	31	----	46
Oct. 7 (Naval Observatory)	11 26	+40.0	311.0	+18.0	15	----	15
Oct. 8 (Naval Observatory)	11 20	No spots			----	----	----
Oct. 9 (Naval Observatory)	10 38	No spots			----	----	----
Oct. 10 (Naval Observatory)	10 37	No spots			----	----	----
Oct. 11 (Naval Observatory)	10 41	No spots			----	----	----
Oct. 12 (Naval Observatory)	10 48	No spots			----	----	----
Oct. 13 (Naval Observatory)	10 40	No spots			----	----	----
Oct. 14 (Mount Wilson)	14 15	+37.0	214.1	+1.0	----	10	10
Oct. 15 (Naval Observatory)	10 44	No spots			----	----	----
Oct. 16 (Naval Observatory)	10 29	No spots			----	----	----
Oct. 17 (Naval Observatory)	10 44	No spots			----	----	----
Oct. 18 (Naval Observatory)	10 55	No spots			----	----	----
Oct. 19 (Naval Observatory)	10 50	−77.0	36.0	−15.0	93	----	93
Oct. 20 (Naval Observatory)	10 35	−62.0	37.9	−15.0	93	----	93
Oct. 21 (Naval Observatory)	10 32	−50.0	36.8	−15.0	154	----	154
Oct. 22 (Naval Observatory)	11 5	−37.0	36.3	−16.0	154	----	154
Oct. 23 (Naval Observatory)	11 5	−23.5	36.6	−15.5	154	----	154
Oct. 24 (Naval Observatory)	10 39	−11.0	36.2	−16.0	123	----	123
Oct. 25 (Naval Observatory)	10 41	+2.0	35.9	−16.0	93	----	93
Oct. 26 (Naval Observatory)	10 35	+15.0	35.8	−16.0	123	----	123
Oct. 27 (Naval Observatory)	10 26	+28.0	35.7	−16.0	93	----	93
Oct. 28 (Mount Wilson)	11 40	+43.0	36.8	−15.5	----	121	121
Oct. 29 (Naval Observatory)	10 38	+56.5	37.7	−16.5	62	----	62
Oct. 30 (Naval Observatory)	10 34	+70.0	38.1	−17.0	62	----	62
Oct. 31 (Naval Observatory)	10 40	No spots			----	----	----
Mean daily area for October							66

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR OCTOBER, 1931

(Data dependent alone on observations at Zurich and its station at Arosa)

[Data furnished through the courtesy of Prof. W. Brunner, University of Zurich, Switzerland]

October, 1931	Relative numbers	October, 1931	Relative numbers	October, 1931	Relative numbers
1	10	11	7	21	10
2	21	12	0	22	9
3	14	13	Mc 8	23	24
4	a 18	14	9	24	18
5	15	15	8	25	----
6	15	16	0	26	----
7	7	17	0	27	11
8	8	18	0	28	10
9	7	19	d 8	29	9
10	0	20	8	30	----
				31	Wc 18

Mean: 28 days=9.7.

a=Passage of an average-sized group through the central meridian.
c=New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central zone.
d=Entrance of a large or average-sized center of activity on the east limb.